Earthquakes and Tsunamis

Grades K-4

Overview:

In this lesson, students examine earthquakes and their role in tsunami generation.

Targeted Alaska Grade Level Expectations:

Science

[3-4] SA1.1 The student demonstrates an understanding of the processes of science by asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring, and communicating.

[4] SD2.2 The student demonstrates an understanding of the forces that shape Earth by identifying causes (i.e., earthquakes, tsunamis, volcanoes, landslides, and avalanches) of rapid changes on the surface.

Objectives:

The student will:

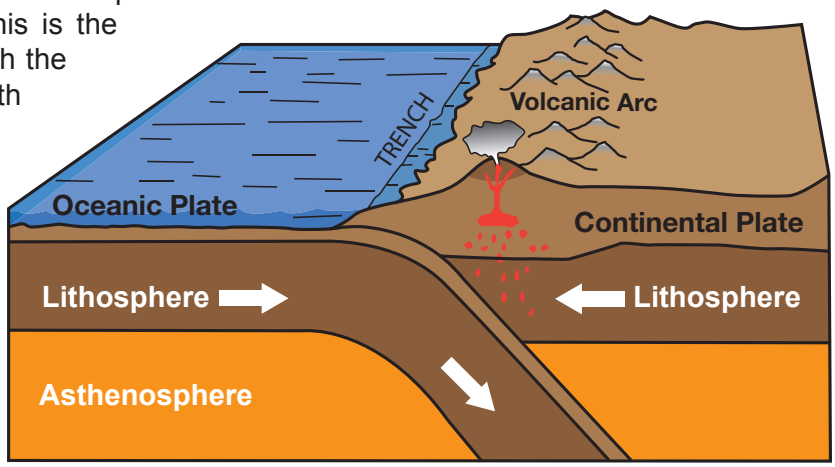
- model vertical and horizontal fault movements;
- relate occurrence of earthquakes to plate boundaries;
- identify the vertical fault movement as the most common trigger of tsunamis; and
- identify a strong earthquake and proximity to the ocean as necessary ingredients for a tsunami.

Materials:

- VIDEO FILES: “Earthquake Time Machine” and “How a Tsunami Forms”
- VISUAL AID: “Oceanic Plate meets Continental Plate”
- STUDENT WORKSHEET: “Tsunamigenic Earthquakes”

Science Basics:

Earthquakes are the most common source of tsunami waves. They don’t often generate tsunamis but they have produced approximately 83% of recorded tsunamis in the Pacific Ocean. Tsunamigenic earthquakes usually have a minimum Richter scale magnitude of 7.5. These earthquakes must also be located near or underneath the ocean. Volcanic action can generate earthquakes, but most earthquakes are generated by fault movements at plate boundaries. Some of the strongest earthquakes occur in subduction zones where an oceanic plate slides under a continental plate; this is the case of the Aleutian Megathrust with the Pacific plate sliding under the North American plate along the Aleutian region and south of Alaska.



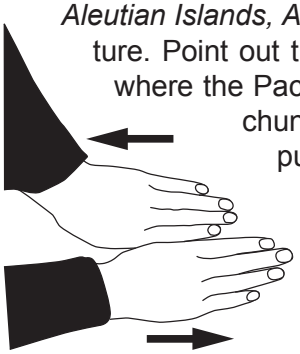
At the time of a tsunamigenic earthquake, a large area of the sea floor (up to 100,000 square kilometers) moves vertically, up to several meters. Tsunami generation depends on several factors: the degree of movement

on the seafloor, the area of the rupture zone, the degree of underground landslides occurring simultaneously, and the efficiency of energy transference from the crust to the ocean water.

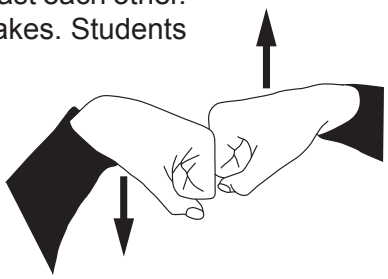
According to the NOAA/WDC Historical Tsunami Database at the National Geophysical Data Center, approximately 90% of recorded tsunamis affecting Alaska were triggered by earthquakes. Regarding earthquakes, Alaska has an average of 1,000 earthquakes each month, 11% of the world's recorded earthquakes, and three of the ten largest earthquakes in the world occurred in Alaska.

Activity Procedure:

1. Explain that students will learn about earthquakes and how they can create tsunamis.
2. Explain that earthquakes are the cause of most tsunamis, but few earthquakes make tsunamis. Few earthquakes happen because of volcanoes.
3. Access the *Earthquake Time Machine* video file on the ATEP video playlist. Point out the approximate location of your community. Explain once the **GO** button is pressed, the screen will show where large earthquakes happened since 1898 to 2006. Click on the **GO** button. Explain that all the circles are strong earthquakes and few of them made tsunamis. Ask a stu-dent to point out the area where most of the earthquakes occur. *They mostly occur along the southern edge of the Aleutian Islands, Alaska Peninsula and Kodiak.* Click on the **Aleutian Megathrust** feature. Point out the long red line that runs parallel to this region: the Aleutian Megathrust. This is where the Pacific Plate and the North American Plate push against each other. Plates are large chunks of land that are pushed around by the molten rock inside Earth. The Pacific Plate pushes under the North American Plate.



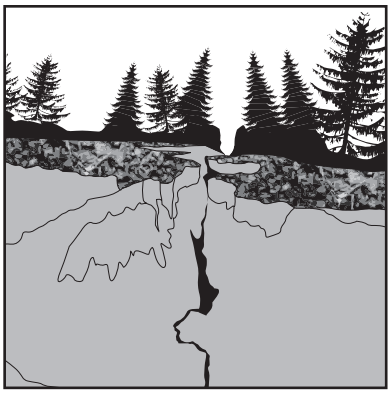
4. Explain when plates move they can move in different ways – sideways and up and down. The sideways movement along plate boundaries can be modeled by sliding two hands (plates) past each other. This is one way plates can cause earthquakes. Students should imitate your actions as you model.



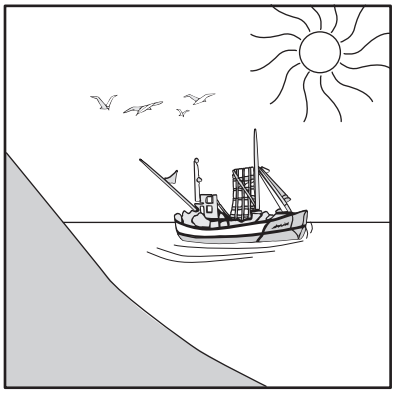
5. The up and down movement of plates can be modeled by making fists (the plates) and pressing the fists together along the knuckles. In normal faulting, one plate will push downward, so slide one fist downward along the knuckles. Sometimes the pressure will build up so much that the other plate will suddenly shove upward.
6. Display VISUAL AID: "Oceanic Plate meets Continental Plate" and point out the different features of the visual aid and explain that this shows a downward movement of the ocean plate. Relate the motions of step 5 (the up and down movements) to the visual aid. This is what creates large tsunamigenic earthquakes along the Aleutian Islands.
7. Explain there are many earthquakes around the world everyday. Emphasize the earthquakes that could make a tsunami have to be very strong and they have to be near, or under, the ocean. The up and down movement of plates is more likely to generate tsunamis more than the sideways motion of plates. Click on the **Rupture Zones** feature on the Earthquake Time Machine. The large red patches on the map show the large areas of earthquakes that started, or generated, tsunamis.
8. Open VIDEO FILE: "How a Tsunami Forms." Relate the hand demonstration to the action of the area of disturbance.
9. Distribute STUDENT WORKSHEET: "Tsunamigenic Earthquakes" for students to complete.

Answers:

1. Student's drawing should depict vertical fault movement and lateral movement.
2. A star should identify the vertical fault movement.
3. No
4. The following two pictures should be circled:



strong earthquake



ocean

Name:_____

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Student Worksheet

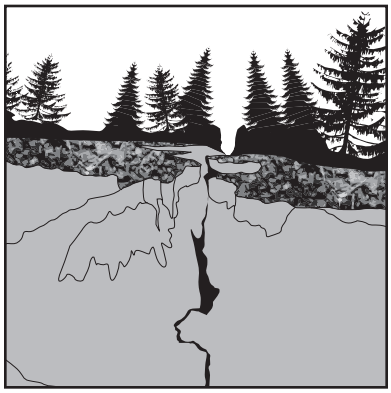
Tsunamigenic Earthquakes

1. Draw a picture that shows the two ways Earth's plates can move against each other.

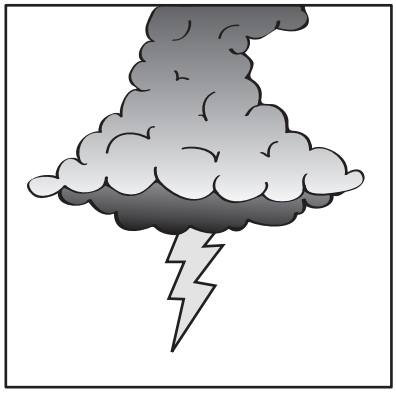
2. On your picture above, draw a star (*) next to the kind of earthquake movement that would most likely make a tsunami.

3. Do all earthquakes make tsunamis? _____

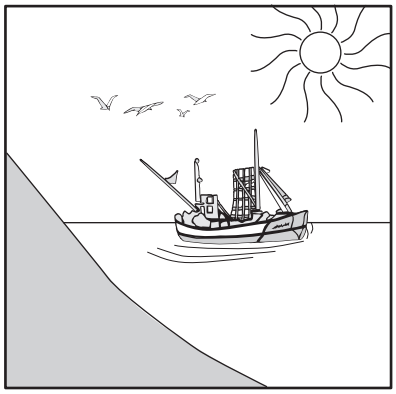
4. (Circle) the items needed for a tsunami to form.



strong earthquake



storm



ocean